CLIPPEDIMAGE= JP02001135477A

PAT-NO: JP02001135477A

DOCUMENT-IDENTIFIER: JP 2001135477 A

TITLE: ORGANIC EL DISPLAY ELEMENT

PUBN-DATE: May 18, 2001

INVENTOR-INFORMATION:

| NAME | COUNTRY |
|---|---|
| IWAZAWA, TOSHIYUKI | N/A |
| HORI, YOSHIKAZU | N/A |

ASSIGNEE-INFORMATION:

| NAME | COUNTRY |
|---|---|
| MATSUSHITA ELECTRIC IND CO LTD | N/A |

APPL-NO: JP11315186

APPL-DATE: November 5, 1999

INT-CL (IPC): H05B033/02;H05B033/14

ABSTRACT:

PROBLEM TO BE SOLVED: To increase light-producing efficiency of an organic EL
display element used for various displays.

SOLUTION: This organic EL display element has such a structure in which on a
transparent plate 11, a transparent electrode 12, light-emitting color material
13, metal electrode 14 and an insulation plate 15 are laminated in

order, the
transparent electrode 12 and the metal electrode 14 constitute an anode and a
cathode respectively, and one side of the transparent plate 11 not contacting
with the transparent electrode 12 has a shape of a convex lens. By using a
convex lens, light-producing efficiency can be improved, and a bright display
element can be obtained.

(19)日本国特許庁（ＪＰ）　(12)公開特許公報（Ａ）　(11)特許出願公開番号
特開2001－135477
（P2001－135477A）
(43)公開日　平成13年５月18日(2001.5.18)

| (51)Int.Cl.' | 識別記号 | ＦＩ | テーマコード(参考) |
|---|---|---|---|
| Ｈ０５Ｂ　33/02 | | Ｈ０５Ｂ　33/02 | ３Ｋ００７ |
| 33/14 | | 33/14 | Ａ |

審査請求　未請求　請求項の数９　ＯＬ　（全 10 頁）

(21)出願番号　特願平11－315186

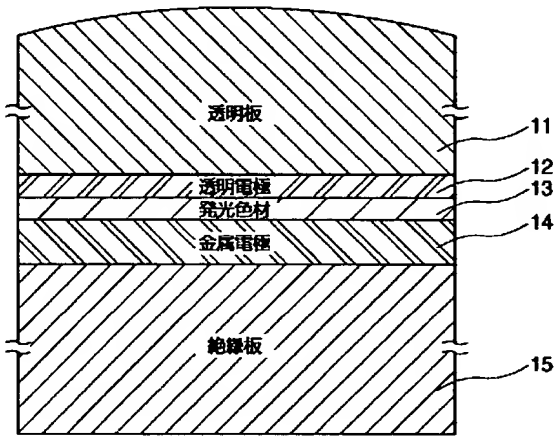
(22)出願日　平成11年11月５日(1999.11.5)

(71)出願人　000005821
松下電器産業株式会社
大阪府門真市大字門真1006番地
(72)発明者　岩澤　利幸
神奈川県川崎市多摩区東三田３丁目10番１号　松下技研株式会社内
(72)発明者　堀　義和
神奈川県川崎市多摩区東三田３丁目10番１号　松下技研株式会社内
(74)代理人　100097445
弁理士　岩橋　文雄　（外２名）

Ｆターム(参考)　3K007 AB03 BA06 BB06 CA00 CA01
CA05 CB01 CC01 DA00 DB03
EB00 FA01

(54)【発明の名称】　有機ＥＬ表示素子

(57)【要約】
【課題】　各種表示に用いられる有機ＥＬ表示素子において、光の取り出し効率を高めることを目的とする。
【解決手段】　透明板１１上に、透明電極１２、発光色材１３、金属電極１４、絶縁板１５を順次積層し、透明電極１２を陽極に、金属電極１４を陰極とし、透明板１１の透明電極１２と接してない側の面が一枚の凸レンズ状である構成の有機ＥＬ表示素子としたものであり、凸レンズを用いることにより光取り出し効率が向上し、明るい表示素子を得る事が出来る。



1

【特許請求の範囲】

【請求項１】　透明板と、前記透明板の上に順次積層された透明電極、発光色材及び金属電極を有し、前記透明板の前記透明電極と接してない側の面が一枚の凸レンズ状である有機ＥＬ表示素子。

【請求項２】　透明板と、前記透明板の上に順次積層された透明電極、発光色材及び金属電極を有し、前記透明板の両面が一枚の凸レンズ状である有機ＥＬ表示素子。

【請求項３】　透明板と、前記透明板の上に順次積層された透明電極、発光色材及び金属電極を有し、前記透明板の前記透明電極と接する面が所定の数の微小凸レンズ状である有機ＥＬ表示素子。

【請求項４】　透明板と、前記透明板の上に順次積層された透明電極、発光色材及び金属電極を有し、前記透明板の前記透明電極と接してない側の面が一枚の凸レンズ状であり、前記透明板の前記透明電極と接する面が所定の数の微小凸レンズ状である有機ＥＬ表示素子。

【請求項５】　透明板と、前記透明板の上に順次積層された透明電極、発光色材及び金属電極を有し、前記透明板の両面が相応した所定の数の微小凸レンズ状である有機ＥＬ表示素子。

【請求項６】　透明板と、前記透明板の上に順次積層された透明電極、発光色材及び金属電極を有し、前記透明板の前記透明電極と接してない側の面が所定の数の微小凸レンズ状である有機ＥＬ表示素子。

【請求項７】　微小凸レンズがマトリクス型表示の画素毎にそれぞれ形成されている請求項３ないし６のいずれか記載の有機ＥＬ表示素子。

【請求項８】　微小凸レンズが、マトリクス型表示の赤、緑及び青を含む１画素単位とする絵素毎に形成されている請求項３ないし６のいずれか記載の有機ＥＬ表示素子。

【請求項９】　金属電極の上に絶縁板を有する請求項１ないし８のいずれか記載の有機ＥＬ表示素子。

【発明の詳細な説明】

2

＊【０００１】

【発明の属する技術分野】本発明は、有機ＥＬ表示素子の高効率発光取り出しの構成に関する。

【０００２】

【従来の技術】従来の有機ＥＬ表示素子では、図１２のように透明で平板なガラス板７１、ＩＴＯに代表される透明電極６２、発光色材６３（正孔注入材７１、正孔輸送材７２、発光材７３、電子輸送材７４）、金属電極６４、絶縁板６５を順次積層した構成で、金属電極６４を陰極、透明電極６２を陽極にし電圧を印加すると発光色材６３の中の発光材７３で光が励起し、その光は平板なガラス板７１を通して外部に到達する。

【０００３】

【発明が解決しようとする課題】ところが図１３に示す様に、ガラスを通して外部である空中に光が出る場合、ガラスより空気の屈折率が小さいので臨界角θより大きい角度で出射した光は全反射する。図１３は図１２のガラス板７１の部分の断面図であり、発光材７３からの光が図１３において下から上へ通過する。一般に用いられるガラス板の屈折率は約１．５であるので、ガラス中から空気中へ光が出射する臨界角は下記数式１で示すように、４１．８度となる。

【０００４】

【数１】

$$\mathrm{Sin}\,\theta = \frac{1}{n} = \frac{1}{1.5}$$

$$\theta = 41.8^{\circ}$$

（ｎ：ガラスの屈折率＝1.5）

【０００５】それ故、理論上の取り出し効率は下記の式により約２５．４％となり、かなりのの光が無駄になっていることになる。

【０００６】

【数２】

$$\text{取り出し効率}\ \eta = \frac{\text{半径Ｒの球の中心角}2\theta\text{分の表面積}}{\text{半径Ｒの半球の表面積}}$$

$$= \frac{\pi\{a^2 + (R-b)^2\}}{2\pi R^2} = 25.4\%$$

【０００７】本発明は、このような有機ＥＬ表示素子において、光の取り出し効率を高めることを目的とする。

【０００８】

【課題を解決するための手段】この課題を解決するために本発明は、ガラス板から空気中へ光が出射する時、出射角が臨界角より大きくなる確率をできるだけ小さくしたものである。具体的にはガラス板の片面または両面を凸レンズ状にすると同時にそれに相応して金属電極を発光側から見て凹面鏡状態にするように構成したものである。

【０００９】これにより、透明板であるガラスから空気媒質である観測側に出射する角度が上記の臨界角より小さくなる確立が増大し、光取り出し効率が向上し、明るい表示素子が得られる。

【００１０】

【発明の実施の形態】本発明の請求項１記載の発明は、透明板と、前記透明板の上に順次積層された透明電極、発光色材及び金属電極を有し、前記透明板の前記透明電

極と接してない側の面が一枚の凸レンズ状である有機ＥＬ表示素子であり、凸レンズを用いることにより光取り出し効率が向上し、明るい表示素子を得ることができるという作用を有する。

【００１１】請求項２記載の本発明は、透明板と、前記透明板の上に順次積層された透明電極、発光色材及び金属電極を有し、前記透明板の両面が一枚の凸レンズ状である有機ＥＬ表示素子であり、凸レンズを用い、更に凹面鏡で光を集束させることにより光取り出し効率が向上し、明るい表示素子を得ることができるという作用を有する。

【００１２】請求項３記載の本発明は、透明板と、前記透明板の上に順次積層された透明電極、発光色材及び金属電極を有し、前記透明板の前記透明電極と接する面が所定の数の微小凸レンズ状である有機ＥＬ表示素子であり、この微小凸レンズに対応する金属電極がそれぞれ多数の微小凹面鏡となり、光を集束させるので臨界角以上で光を出射する確率を小さくし、光取り出し効率が向上し、明るい表示素子を得ることができるという作用を有する。

【００１３】請求項４記載の本発明は、透明板と、前記透明板の上に順次積層された透明電極、発光色材及び金属電極を有し、前記透明板の前記透明電極と接してない側の面が一枚の凸レンズ状であり、前記透明板の前記透明電極と接する面が所定の数の微小凸レンズ状である有機ＥＬ表示素子であり、多数の微小凹面鏡が光を集束し、かつ凸レンズを通すことにより光取り出し効率が向上し、明るい表示素子を得ることができるという作用を有する。

【００１４】請求項５記載の本発明は、透明板と、前記透明板の上に順次積層された透明電極、発光色材及び金属電極を有し、前記透明板の両面が相応した所定の数の微小凸レンズ状である有機ＥＬ表示素子であり、多数の微小凹面鏡が光を集束し、かつ微小凹面鏡と１対１で対応した微小凸レンズを通すことにより光取り出し効率が向上し、明るい表示素子を得ることができるという作用を有する。

【００１５】請求項６記載の本発明は、透明板と、前記透明板の上に順次積層された透明電極、発光色材及び金属電極を有し、前記透明板の前記透明電極と接してない側の面が所定の数の微小凸レンズ状である有機ＥＬ表示素子であり、多数の微小凸レンズを通すことにより光取り出し効率が向上し、明るい表示素子を得ることができるという作用を有する。

【００１６】請求項７記載の本発明は、微小凸レンズがマトリクス型表示の画素毎にそれぞれ形成されている請求項３ないし６のいずれか記載の有機ＥＬ表示素子であり、各画素に対応した凹面鏡が光を集束し、かつ画素と１対１で対応した凸レンズを通すことにより光取り出し効率が向上し、明るい表示素子を得ることができるという作用を有する。

【００１７】請求項８記載の本発明は、微小凸レンズが、マトリクス型表示の赤、緑及び青を含む１画素単位とする絵素毎に形成されている請求項３ないし６のいずれか記載の有機ＥＬ表示素子であり、各絵素に対応した凹面鏡が光を集束し、かつ絵素と１対１で対応した凸レンズを通すことにより光取り出し効率が向上し、明るい表示素子を得ることができるという作用を有する。

【００１８】請求項９記載の本発明は、金属電極の上に絶縁板を有する請求項１ないし８のいずれか記載の有機ＥＬ表示素子であり、絶縁板を無くすことにより、軽量かつ安価にできるという作用を有する。

【００１９】以下、本発明の各実施の形態につき、図面を参照しながら説明をする。

【００２０】（実施の形態１）以下、本発明第１の実施の形態について図面を参照しながら説明する。

【００２１】図１は、発光取り出し効率を向上させた有機ＥＬ素子の断面図を示す。図１において１１は透明板であって、主に透明ガラス、又は透明な樹脂板からなる片面の凸レンズである。１２は透明電極であって、主に透明導電材のＩＴＯを用いる。１３は発光色材であって発光のメカニズムをつかさどる材料を総称したものである。１４は金属電極であり、アルミニウム、リチウムーマグネシウム等の仕事関数が５程度の金属が用いられる。１５は絶縁板であり、金属電極１４を他の物質と電気的に分離したり、積層膜を保護するものであって、この絶縁板１５はガラス板や、絶縁薄膜の場合もある。絶縁薄膜の場合は金属電極１４と反対の面に回路基板が付加されることもある。表示素子の形成法として、透明板１１を基板とし、その上から薄膜状の、透明電極１２、発光色材１３、金属電極１４、のそれぞれの膜を順次積層した後、絶縁板１５を積層するが、場合によっては絶縁板１５を省略することもある。

【００２２】もう１つの作成法としては、絶縁板１５を基板とし、薄膜状の、金属電極１４、発光色材１３、透明電極１２のそれぞれの膜を順次積層した後、透明板１１を積層する。

【００２３】透明板１１は図２に示すように、片面凸レンズの円に内接する四角形を切り出したものである。図２（ａ）は片面レンズを上から見た図であり、（ｂ）はＡＡ‘断面の断面図である。図２では正方形に切り出したものを示したが、長方形でもよい。

【００２４】従来の有機ＥＬ素子と本実施の形態との違いは、透明板１１が平行平板か片面凸レンズかの差である。図３に透明板の表面部分の断面図を従来例とともに示す。図３（ａ）は従来の素子、（ｂ）は本実施の形態の断面図を示したものである。発光色材１３の発光材から発せられる光は発光色材１３中の正孔輸送材、透明電極１２を通過し透明板１１に達する。同図では下から上へ光は透過する。正孔輸送材、透明電極１２の層はそれ

ぞれ５０～１００ｎｍであり、透明電極１２にＩＴＯを用いた場合、ＩＴＯの屈折率は約１．８であり、透明板１１をガラスとした時の屈折率は約１．５であるから、発光材からの光は透明板１１へはほぼ直進すると考えられる。

【００２５】そこで図３（ａ）に示すように臨界角θで入射した光は積層面の反対側である観察側には出射できないが、（ｂ）のように、片面凸レンズ状になっている場合は、出射点Ｐの接線ｇを基準線にするため臨界角θで出射される光も透明板１１を通過し観測側に出射でき、光として感知することができる。つまり光の取り出し効率を高めることができ、従来のものより明るい表示を行うことができる。

【００２６】（実施の形態２）以下、本発明第２の実施の形態について図面を参照しながら説明する。

【００２７】図４は、第２の実施の形態における有機ＥＬ素子の断面図を示す。図４において２１は透明板、２２は透明電極、２３は発光色材、２４は金属電極、２５は絶縁板でありそれぞれ第１の実施の形態である図１で説明したものと同じである。

【００２８】第１の実施の形態と異なる点は透明板２１が両面凸レンズであること、それに伴い透明電極２２、発光色材２３、金属電極２４、絶縁板２５が観測側から見て凹面状になり、従って金属電極２４の電極を形成している部分が凹面鏡になることである。図３（ｃ）は本実施の形態における有機ＥＬ素子透明板の表面部分の断面図を示す。第１の実施の形態で説明したように臨界角θで出射した光はＰ点で透明板２１を通過し観測側に出射でき、光として感知できる。さらに金属電極が凹面鏡を形成しているので光を発散させず、集光し、平面の場合より明るくなる。以上の理由から、従来例に比べ、光の取り出し効率を高めることができ、明るい表示を行うことができる。

【００２９】（実施の形態３）以下、本発明第３の実施の形態について図面を参照しながら説明する。

【００３０】図５は本実施の形態における有機ＥＬ素子の概念図を示し、同図（ａ）は平面図、同図（ｂ）は断面図である。図５に示すように画像表示等に用いられ、ｍ行（図面の縦方向）とｎ列（横方向）からなる画素単位で表示するマトリクスタイプの表示素子である。同図において３６は凸レンズを示す。

【００３１】図６は、本実施の形態における有機ＥＬ素子の拡大断面図である。

【００３２】図６において３１は透明板であり図５に示すように画素単位で積層側に凸状のレンズ、観測側は平面で構成されている。３２は透明電極であって、それぞれが凸レンズの透明板３１側に凹の面を持つ薄膜であり、各縦方向の画素を連ねた行方向の共通電極となっている。３３はそれぞれが透明板３１側に凹の面を持つ薄膜の発光色材、３４はそれぞれが透明板３１側に凹状の面を持つ薄膜の金属電極であり、各画素毎に凹面鏡を形成する。また各横方向の画素を連ねた列方向の共通電極となっている。３５は金属電極３４側に凹状の面を持つ絶縁板であり、第１の実施の形態で説明したように金属電極３４を他の物質と電気的に分離し、また積層膜を保護するものであって、この絶縁板３５はガラス板や、絶縁薄膜の場合もある。絶縁薄膜の場合は金属電極１４と反対の面に回路基板が付加されることもある。更に透明板３１を基板として積層する場合は、この絶縁板３５は設けない場合がある。

【００３３】図７は透明板３１の凸レンズ部分の拡大断面図であり、同図（ａ）は本実施の形態の素子であり、同図（ｂ）は従来の素子のものである。図７（ｂ）は従来例である図３（ａ）と同様のレンズを持たない透明板の場合について示しており、臨界角θよりも大きい角γで発光色材の発光層より発した光は、観察側である空気と接するガラス境界面で全反射され、観察側に届かない。

【００３４】一方、図７（ａ）は図６の１つの画素について示したものであり、Ａ点から発せられた出射角γの光は一度金属電極３４の凹面鏡で反射され、ガラスと空気の境界面に対し、ほぼ垂直方向になって観察側に到達する。またＡ点からの直接光も観察側に到達し、広い範囲の光を到達させることができることから、図７（ｂ）の場合に比べ発光取り出し効率が増大し、明るい表示を行うことができる。

【００３５】（実施の形態４）以下、本発明第４の実施の形態について図面を参照しながら説明する。

【００３６】本発明は第３の実施の形態と同様に画素単位で表示するマトリクスタイプの表示素子に関するものである。

【００３７】図８は、マトリクスタイプの表示における発光取り出し効率を向上させた有機ＥＬ素子である本実施の形態の断面図を示す。

【００３８】図８において４１は透明板であり積層側は図６の透明板３１と同じ画素単位で積層側に凸状のレンズであり、積層と反対の側である観測側は第１の実施の形態である図１と同じ表示素子全体で１つの片側の凸レンズを形成している。４２は透明電極、４３は発光色材、４４金属電極、４５は絶縁板であり、それぞれ図６の透明電極３２、発光色材３３、金属電極３４、絶縁板３５と同じものである。

【００３９】この実施の形態では第３の実施の形態で説明した作用に加え、上述したように観測側が表示素子全体で１つの片側の凸レンズを形成しているので、第１の実施の形態で説明したように観測側の境界面が平面の場合に比べ発光取り出し効率が向上するという作用も加わる。つまり、図６で示した第３の実施の形態に比べ、発光取り出し効率が向上し、明るい表示を行うことができる。

【００４０】（実施の形態５）以下、本発明第５の実施の形態について図面を参照しながら説明する。

【００４１】本発明も第３の実施の形態と同様に画素単位で表示するマトリクスタイプの表示素子に関するものである。

【００４２】図９は、マトリクスタイプの表示における発光取り出し効率を向上させた有機ＥＬ素子である本実施の形態の断面図を示す。

【００４３】図９において５１は透明板であり積層側は図６の透明板３１と同様の画素単位で積層側に凸状のレンズであり、積層と反対の側である観測側は積層側の各画素毎の凸状のレンズと１対１で対応した観測側に凸状のレンズであり、各画素毎に１ケの両面凸レンズを形成している。５２は透明電極、５３は発光色材、５４金属電極、５５は絶縁板であり、図６の透明電極３２、は発光色材３３、金属電極３４、絶縁板３５と同じものである。

【００４４】図１０は本実施の形態の透明板５１の拡大断面図であり、同図（ａ）は本実施の形態の素子であり、同図（ｂ）は従来例の素子である。図１０（ｂ）は従来例である図３（ａ）と同様のレンズを持たない透明板の場合について示しており、臨界角$\theta$よりも大きい角$\gamma$で発光色材の発光層より発した光は、観察側である空気と接するガラス境界面で全反射され、観察側に届かない。

【００４５】一方、図１０（ａ）は図９の１つの画素について示したものであり、Ａ点から発せられた出射角$\gamma$の光は一度金属電極の凹面鏡で反射され、ガラスと空気の境界面に対し、凸レンズの焦点を法線とする接点で凸方向に屈折して観察側に到達する。またＡ点からの直接光も観察側に到達し、広い範囲の光を到達させることができることから、図１０（ｂ）の場合に比べ発光取り出し効率が増大し、明るい表示を行うことができる。

【００４６】なお、以上のマトリクスタイプ表示の第３、４及び５の実施の形態では、画素単位のマトリクス表示で構成した例で説明したが、カラー表示のように赤、緑、青の各１画素から成る絵素を単位としたマトリクス表示で構成したものについても同様に実施可能である。

【００４７】（実施の形態６）以下、本発明第６の実施の形態について図面を参照しながら説明する。

【００４８】本発明は赤、緑、青を各１画素単位とする絵素単位で表示するマトリクスタイプのカラー表示素子に関するものである。

【００４９】図１１は、マトリクスタイプのカラー表示における発光取り出し効率を向上させた有機ＥＬ素子である本実施の形態の断面図を示す。

【００５０】図１１において６１は透明板であり積層側は平面であり、積層と反対の側である観測側は凸状のレンズであり、各絵素毎に１ケの片面凸レンズを形成している。６２は透明電極、６３は発光色材、６４金属電極、６５は絶縁板であり、図６で示した第３の実施の形態における透明電極３２、は発光色材３３、金属電極３４、絶縁板３５を平板にした場合とと同じものであるが、発光色材６３は１絵素単位として１画素毎に赤（Ｒ）、緑（Ｇ）、青（Ｂ）のそれぞれの発光色材でで区分けされている。

【００５１】絵素単位で考えると本実施の形態は図１及び図３で示した第１の実施の形態と同様に考えられる。それ故、臨界角$\theta$よりも大きい角で出射した光でも観察側に届くことができ従来例に比べ発光取り出し効率が増大し、明るい表示を行うことができる。

【００５２】なお、以上の説明では、絵素単位のマトリクス表示で構成した例で説明したが、第３、４及び５の実施の形態のように画素を単位としたマトリクス表示で構成したものについても同様に実施可能である。

【００５３】また以上の実施の形態では金属電極側に絶縁板を設けた場合について説明したが、絶縁板を持たない構成についても同様に実施可能であることは言うまでもない。

【００５４】

【発明の効果】以上のように本発明によれば、有機ＥＬ表示素子の透明板の表示観測側を凸レンズ状にするか、又は発光色材積層側を凸レンズ状にし、かつ金属電極を凹面鏡として用いるにことにより、発光取り出し効率を増大することができるので、消費電力を増やさず表示を明るくすることができるという有利な効果が得られる。

【図面の簡単な説明】

【図１】本発明第１の実施の形態における有機ＥＬ表示素子の断面図

【図２】同第１の実施の形態における有機ＥＬ表示素子の透明板を示す図

【図３】同第１の実施の形態における有機ＥＬ表示素子の光路を示す概略図

【図４】同第２の実施の形態における有機ＥＬ表示素子の断面図

【図５】同第３の実施の形態における有機ＥＬ表示素子の概略図

【図６】同第３の実施の形態における有機ＥＬ表示素子の断面図

【図７】同第３の実施の形態における有機ＥＬ表示素子の光路を示す概略図

【図８】同第４の実施の形態における有機ＥＬ表示素子の断面図

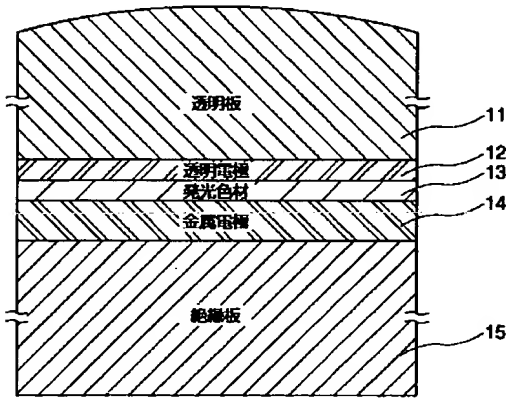
【図９】同第５の実施の形態における有機ＥＬ表示素子の断面図

【図１０】同第５の実施の形態における有機ＥＬ表示素子の光路を示す概略図

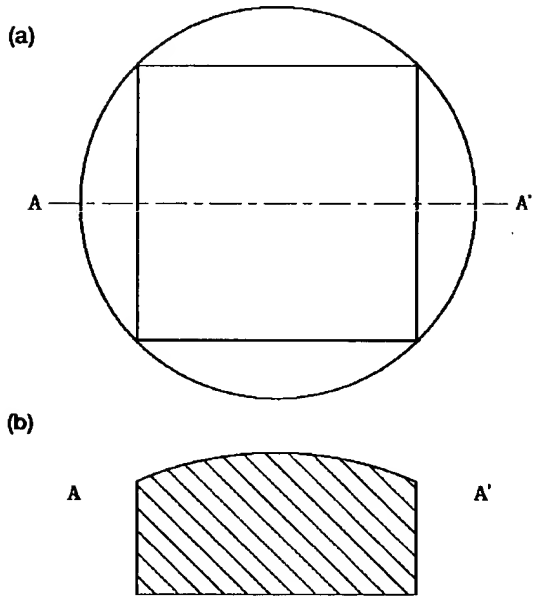
【図１１】同第６の実施の形態における有機ＥＬ表示素子の断面図

【図１２】従来の有機ＥＬ表示素子の断面図
【図１３】従来の有機ＥＬ表示素子の光路を示す概略図
【符号の説明】
１１、２１、３１、４１、５１、６１　透明板
１２、２２、３２、４２、５２、６２　透明電極
１３、２３、３３、４３、５３、６３　発光色材
１４、２４、３４、４４、５４、６４　金属電極
１５、２５、３５、４５、５５、６５　絶縁板
３６　凸レンズ
７１　正孔注入材
７２　正孔輸送材
７３　発光材
７４　電子輸送材

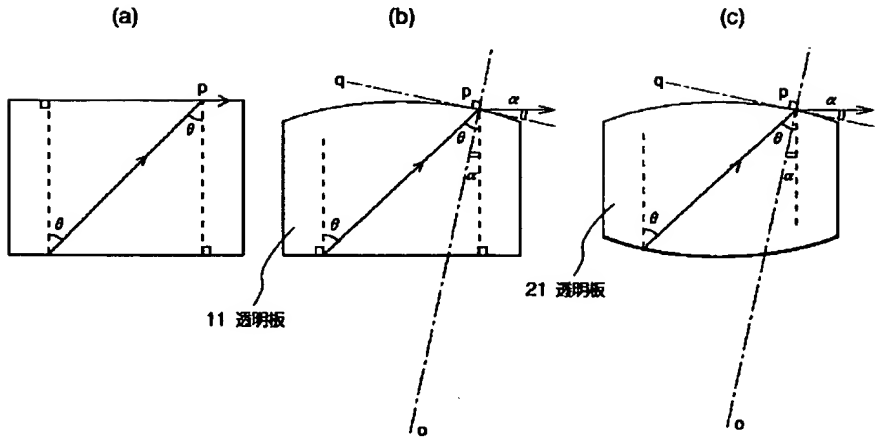
【図１】



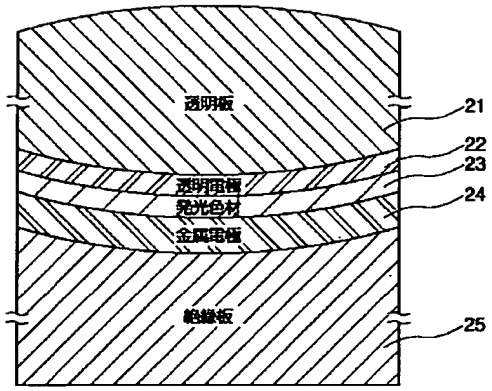

【図２】



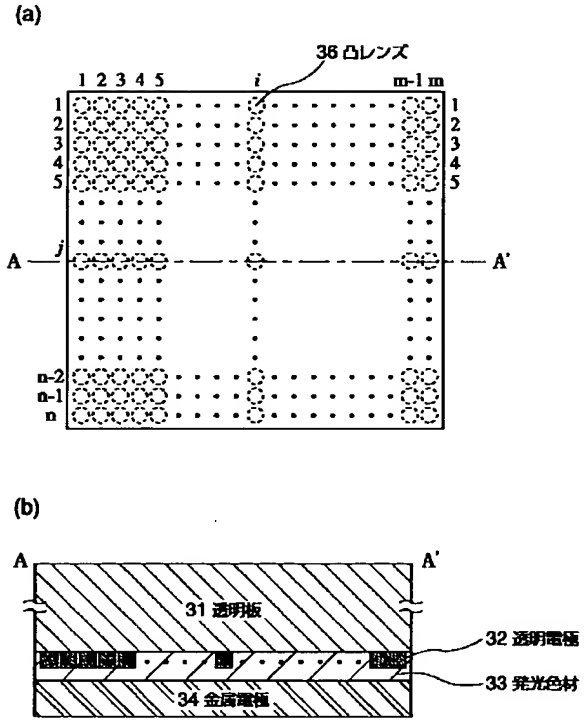

【図３】



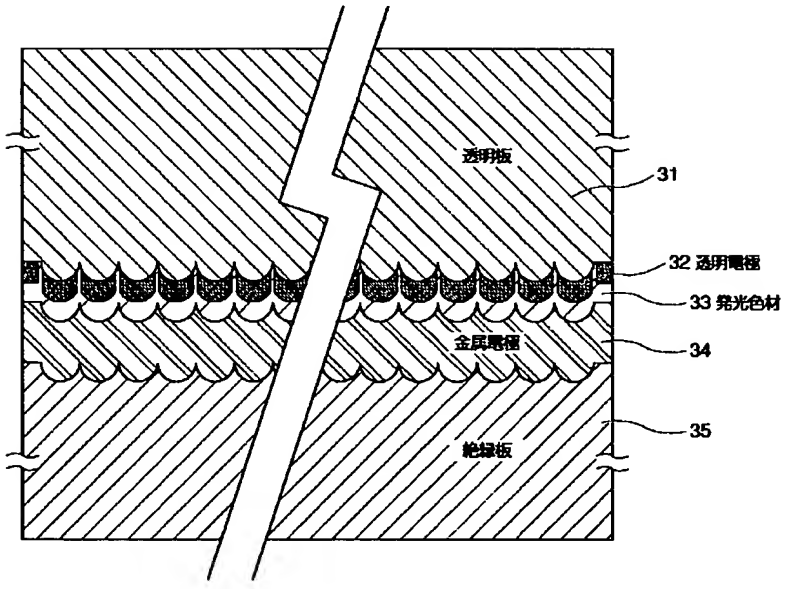
【図4】


透明板
21
22
23
24
透明電極
発光色材
金属電極
絶縁板
25

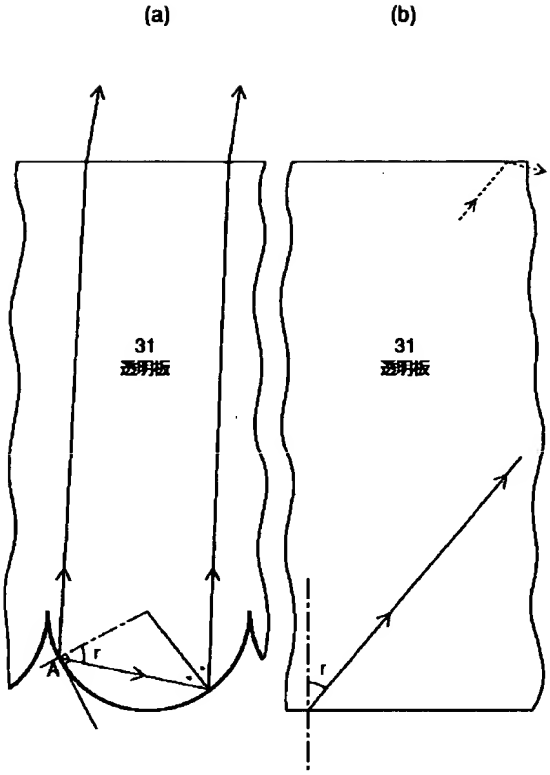
【図5】


(a)
36 凸レンズ
1 2 3 4 5
i
m-1 m
1
2
3
4
5
A
j
A'
n-2
n-1
n
(b)
A
A'
31 透明板
32 透明電極
33 発光色材
34 金属電極

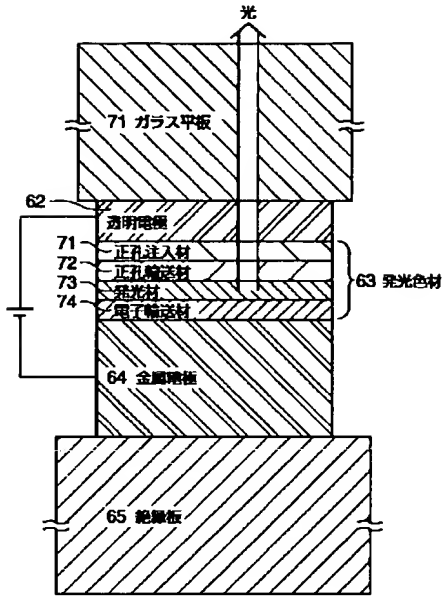
【図6】


透明板
31
32 透明電極
33 発光色材
金属電極
34
35
絶縁板

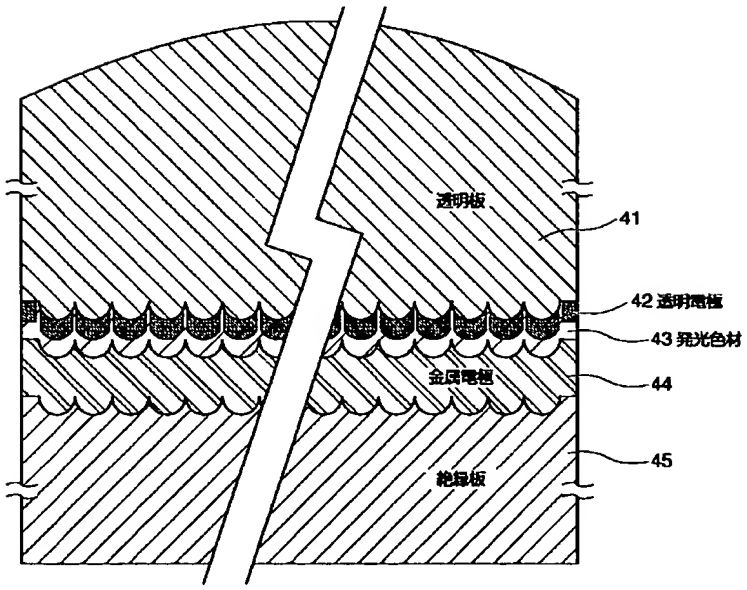
【図７】


(a)
(b)
31
透明板
31
透明板
r
r
A

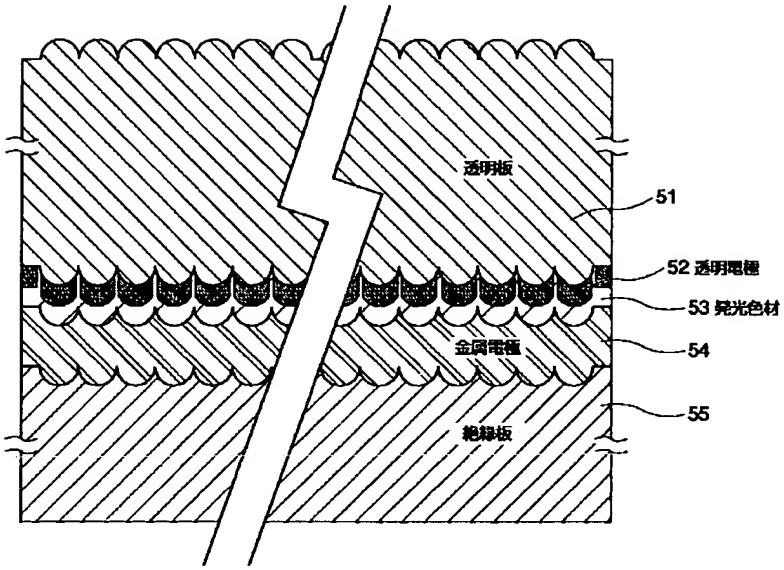
【図１２】


光
71 ガラス平板
62
透明電極
71
正孔注入材
72
正孔輸送材
73
発光材
74
電子輸送材
63 発光色材
64 金属電極
65 絶縁板

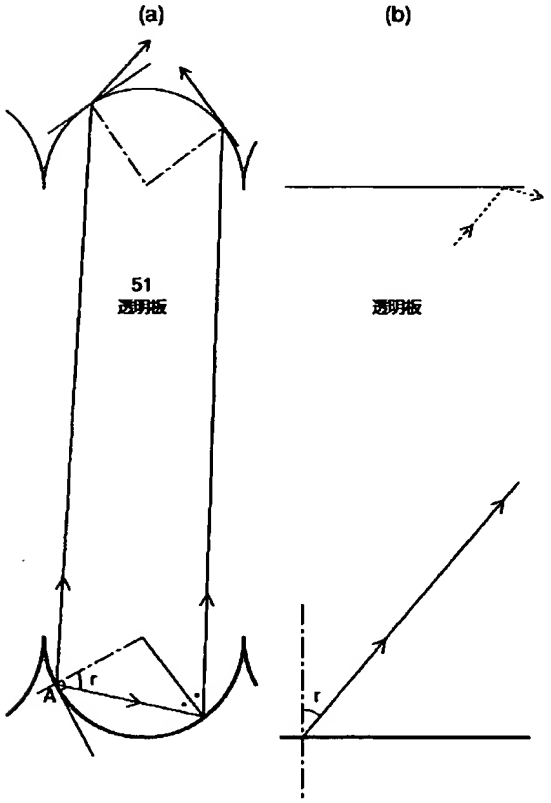
【図８】


透明板
41
42 透明電極
43 発光色材
金属電極
44
45
絶縁板

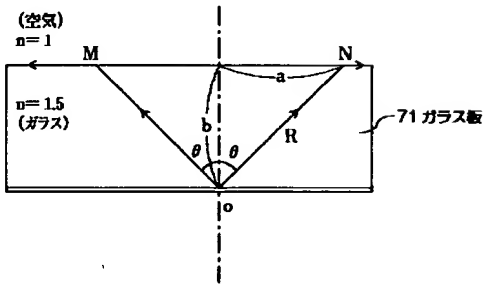
【図9】


透明板
51
52 透明電極
53 発光色材
金属電極
54
55
絶縁板

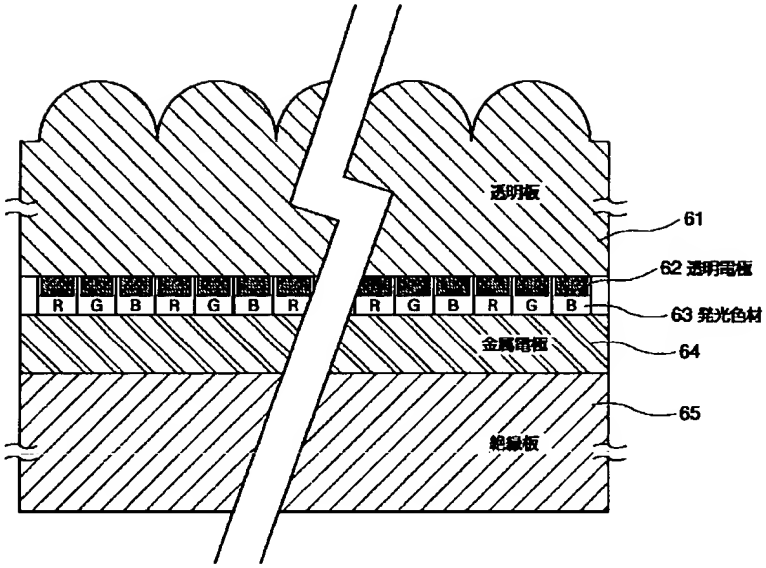
【図10】


(a)
(b)
51
透明板
透明板
r
A
r

【図13】


(空気)
n＝1
M
N
a
n＝1.5
(ガラス)
b
θ
θ
R
71 ガラス板
o

【図11】



---

CLAIMS

---

[Claim(s)]
[Claim 1] Organic EL display device whose field of the side which has the transparent electrode, luminescent color material, and metal electrode by which the laminating was carried out one by one, and has not touched with the aforementioned transparent electrode of the aforementioned transparent board on a transparent board and the aforementioned transparent board has the shape of a convex lens of one sheet.
[Claim 2] Organic EL display device whose both sides of the aforementioned transparent board have the transparent electrode, luminescent color material, and metal electrode by which the laminating was carried out one by one on the transparent board and the aforementioned transparent board, and have the shape of a convex lens of one sheet.
[Claim 3] Organic EL display device whose fields which have the transparent electrode, luminescent color material, and metal electrode by which the laminating was carried out one by one, and touch with the aforementioned transparent electrode of the aforementioned transparent board on a transparent board and the aforementioned transparent board have the shape of a predetermined number of a minute convex lens.
[Claim 4] Organic EL display device whose fields which touch with the aforementioned transparent electrode of the aforementioned transparent board the field of the side which has the transparent electrode, luminescent color material, and metal electrode by which the laminating was carried out one by one on the transparent board and the aforementioned transparent board, and is not in contact with the aforementioned transparent electrode of the aforementioned transparent board has the shape of a convex lens of one sheet, and have the shape of a predetermined number of a minute convex lens.
[Claim 5] Organic EL display device which have the shape of a predetermined number of a minute convex lens with which it has the transparent electrode, luminescent color material, and metal electrode by which the laminating was carried out one by one, and both sides of the aforementioned transparent board ****ed on the transparent board and the aforementioned transparent board.
[Claim 6] Organic EL display device whose fields of the side which has the transparent electrode, luminescent color material, and metal electrode by which the laminating was carried out one by one, and has not touched with the aforementioned transparent electrode of the aforementioned transparent board on a transparent board and the aforementioned transparent board have the shape of a predetermined number of a minute convex lens.
[Claim 7] 6 is [ the claim 3 in which the minute convex lens is formed for every pixel of a matrix type display, respectively, or ] organic EL display device of a publication either.
[Claim 8] 6 is [ the claim 3 which a minute convex lens makes the 1 pixel unit containing the red, green, and blue of a matrix type display and which is formed for every picture element, or ] organic EL display device of a publication either.
[Claim 9] 8 is [ the claim 1 which has an electric insulating plate on a metal electrode, or ] organic EL display device of a publication either.

---

[Translation done.]

* NOTICES *



1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

---

DESCRIPTION OF DRAWINGS

---

[Brief Description of the Drawings]
[Drawing 1] The cross section of organic EL display device in the gestalt of operation of this invention 1st
[Drawing 2] Drawing showing the transparent board of organic EL display device in the gestalt of this 1st operation
[Drawing 3] The schematic diagram showing the optical path of organic EL display device in the gestalt of this 1st operation
[Drawing 4] The cross section of organic EL display device in the gestalt of this 2nd operation
[Drawing 5] The schematic diagram of organic EL display device in the gestalt of this 3rd operation
[Drawing 6] The cross section of organic EL display device in the gestalt of this 3rd operation
[Drawing 7] The schematic diagram showing the optical path of organic EL display device in the gestalt of this 3rd operation
[Drawing 8] The cross section of organic EL display device in the gestalt of this 4th operation
[Drawing 9] The cross section of organic EL display device in the gestalt of this 5th operation
[Drawing 10] The schematic diagram showing the optical path of organic EL display device in the gestalt of this 5th operation

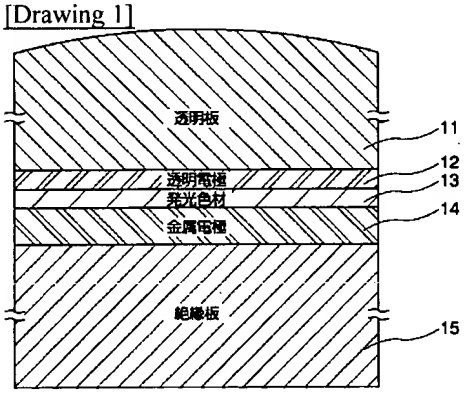
[Drawing 11] The cross section of organic EL display device in the gestalt of this 6th operation
[Drawing 12] The cross section of the conventional organic EL display device
[Drawing 13] The schematic diagram showing the optical path of the conventional organic EL display device
[Description of Notations]
11, 21, 31, 41, 51, 61 Transparent board
12, 22, 32, 42, 52, 62 Transparent electrode
13, 23, 33, 43, 53, 63 Luminescent color material
14, 24, 34, 44, 54, 64 Metal electrode
15, 25, 35, 45, 55, 65 Electric insulating plate
36 Convex Lens
71 Hole-Injection Material
72 Electron Hole Transportation Material
73 Luminescence Material
74 Electronic Transportation Material

---

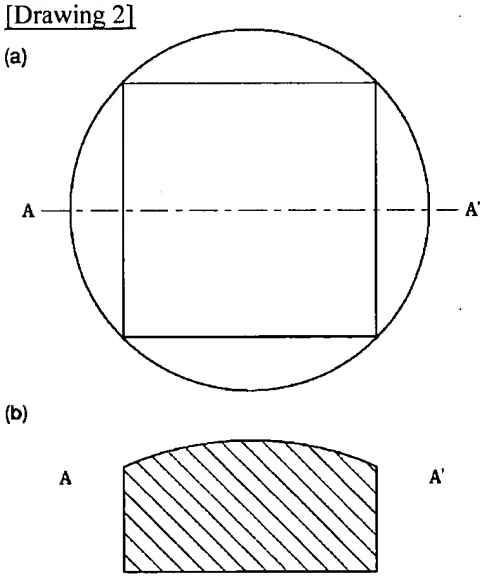
[Translation done.]

DRAWINGS

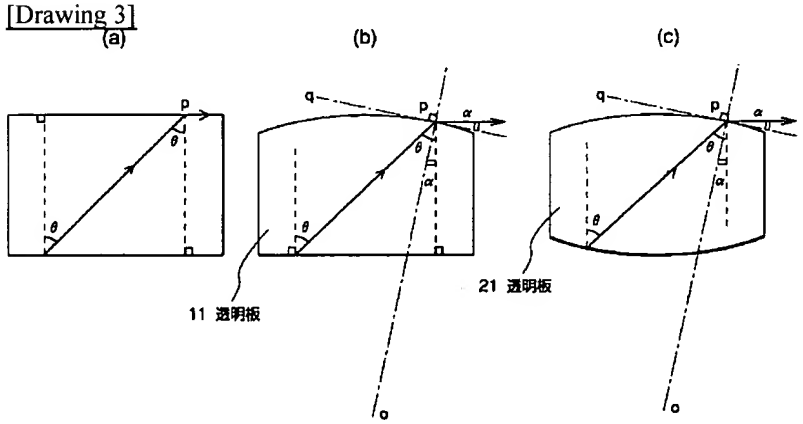
[Drawing 1]



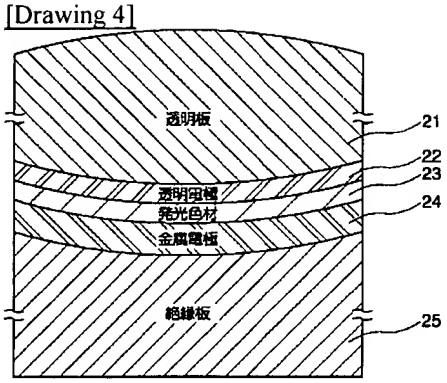

[Drawing 2]




[Drawing 3]

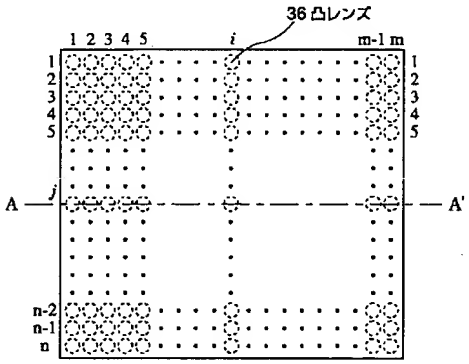


[Drawing 4]

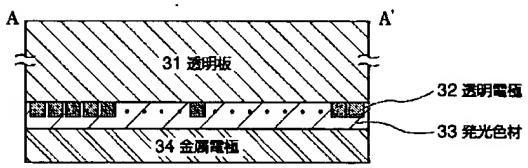



[Drawing 5]

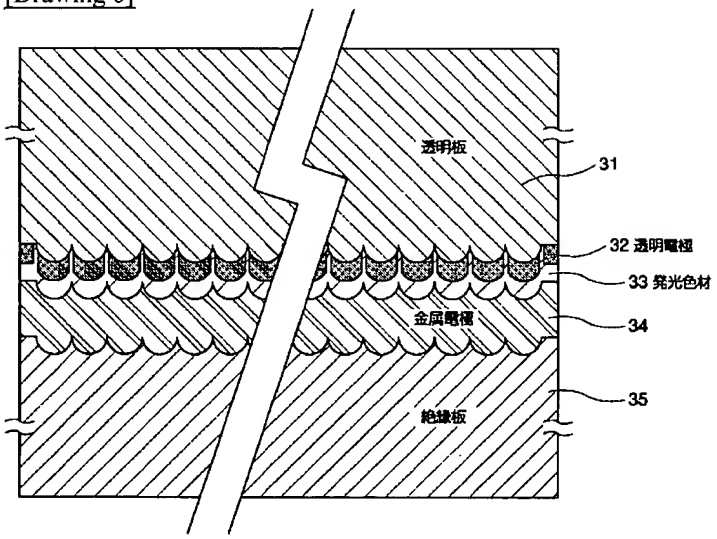
(a)



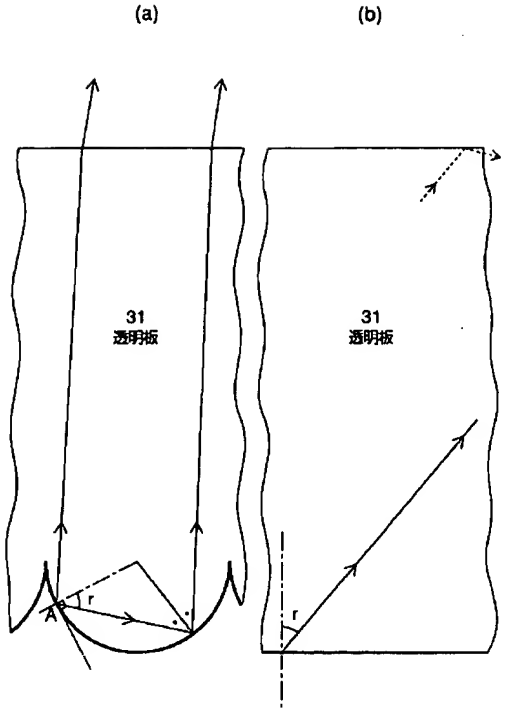

(b)



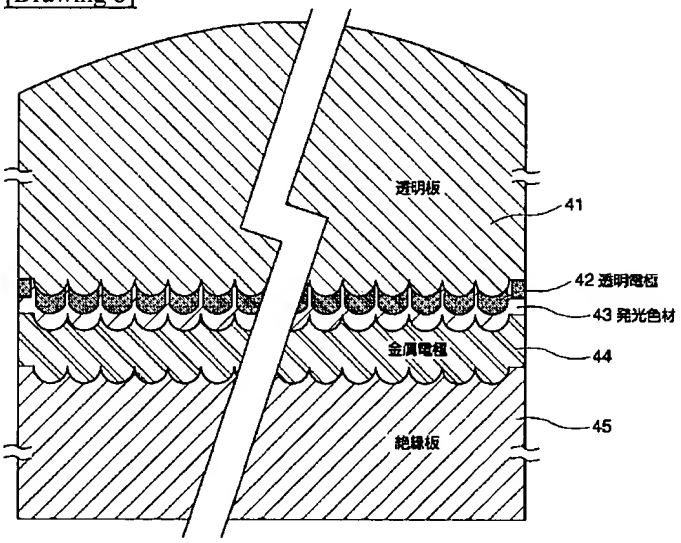

[Drawing 6]



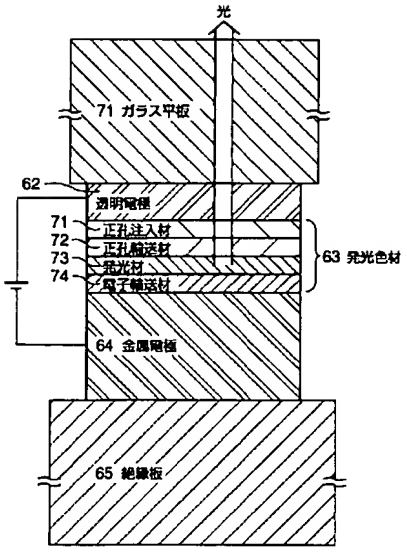

[Drawing 7]



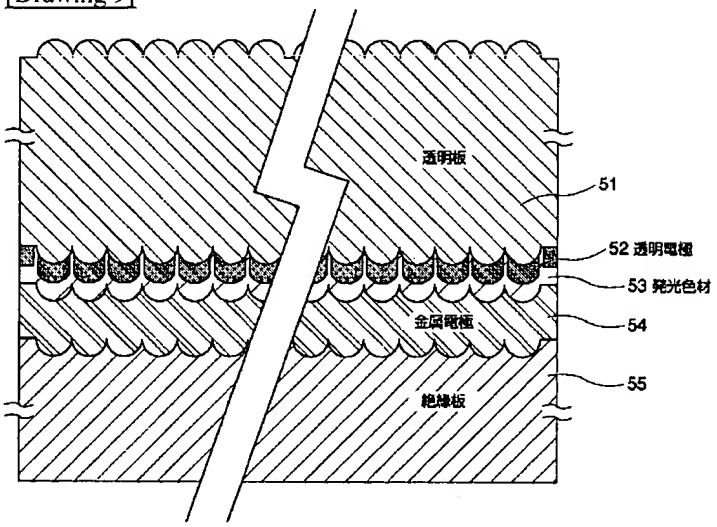

[Drawing 8]



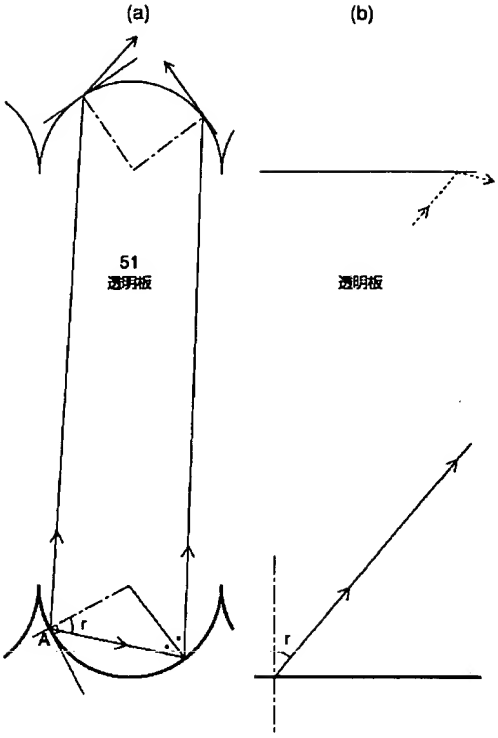

[Drawing 12]



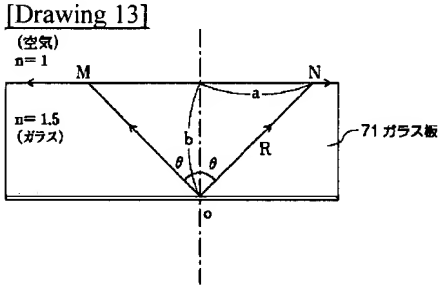

[Drawing 9]



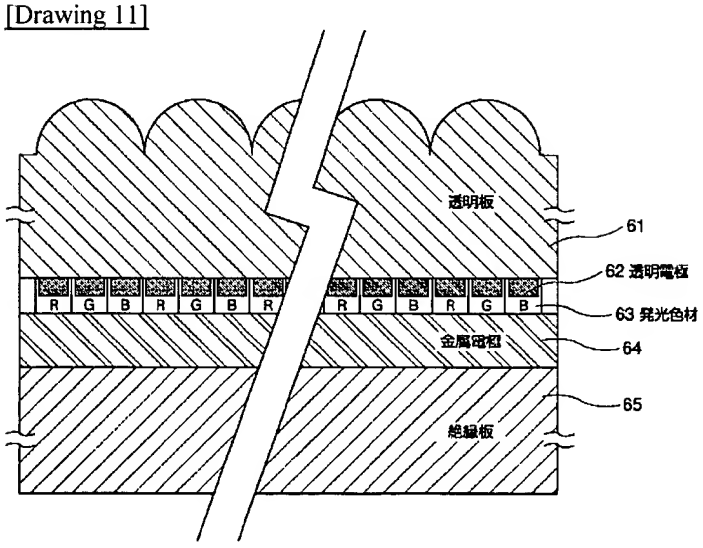

[Drawing 10]




[Drawing 13]




[Drawing 11]




---

[Translation done.]

## DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to the composition of the efficient luminescence ejection of organic EL display device.
[0002]
[Description of the Prior Art] The transparent electrode 62, luminescent color material 63 (the hole-injection material 71, the electron hole transportation material 72, the luminescence material 73, electronic transportation material 74) which are represented by the transparent and monotonous glass plate 71 and ITO like [ in the conventional organic EL display device ] drawing 12 , If a metal electrode 64 is used as cathode, a transparent electrode 62 is used as an anode plate and voltage is impressed with the composition which carried out the laminating of a metal electrode 64 and the electric insulating plate 65 one by one, light will excite by the luminescence material 73 in the luminescent color material 63, and the light will reach outside through the monotonous glass plate 71.
[0003]
[Problem(s) to be Solved by the Invention] However, since the refractive index of air is smaller than glass when light comes out to the air which is the exterior through glass, as shown in drawing 13 , total reflection of the light which carried out outgoing radiation at the larger angle than a critical angle theta is carried out. Drawing 13 is the cross section of the portion of the glass plate 71 of drawing 12 , and the light from the luminescence material 73 passes it to up to a lower shell in drawing 13 . Since the refractive index of the glass plate generally used is about 1.5, the critical angle in which light carries out outgoing radiation into air out of glass becomes 41.8 degrees as shown in the following formula 1.
[0004]
[Equation 1]

$$\mathrm{Sin}\,\theta = \frac{1}{n} = \frac{1}{1.5}$$

$$\theta = 41.8^{\circ}$$

（n：ガラスの屈折率＝1.5）

[0005] So, theoretical ejection efficiency will become about 25.4% by the following formula, and a remarkable thing light will be useless.
[0006]
[Equation 2]

$$\text{取り出し効率}\ \eta = \frac{\text{半径Rの球の中心角}2\theta\text{分の表面積}}{\text{半径Rの半球の表面積}}$$

$$= \frac{\pi\{a^2+(R-b)^2\}}{2\pi R^2} = 25.4\%$$

[0007] this invention aims at raising the ejection efficiency of light in such an organic EL display device.
[0008]
[Means for Solving the Problem] In order to solve this technical problem, when light carries out outgoing radiation of this invention into air from a glass plate, it makes as small as possible probability that an outgoing radiation angle will become larger than a critical angle. It constitutes so that it may **** in it, a metal electrode may be seen from a luminescence side and it may change into a concave mirror state at the same time it specifically makes one side or both sides of a glass plate into the shape of a convex lens.
[0009] The establishment to which the angle which carries out outgoing radiation to the observation side which is an air medium by this from the glass which is a transparent board becomes smaller than the above-mentioned critical angle increases, optical ejection efficiency improves, and a bright display device is obtained.
[0010]
[Embodiments of the Invention] Invention of this invention according to claim 1 has the transparent electrode, luminescent color material, and metal electrode by which the laminating was carried out one by one on the transparent board and the

aforementioned transparent board, and the field of the side which is not in contact with the aforementioned transparent electrode of the aforementioned transparent board is organic EL display device which has the shape of a convex lens of one sheet, and its optical ejection efficiency improves by using a convex lens, and it has operation that a bright display device can be obtained.

[0011] this invention according to claim 2 has the transparent electrode, luminescent color material, and metal electrode by which the laminating was carried out one by one on the transparent board and the aforementioned transparent board, it is an organic EL display device whose both sides of the aforementioned transparent board have the shape of a convex lens of one sheet, and its optical ejection efficiency improves by converging light with a concave mirror further using a convex lens, and it has operation that a bright display device can be obtained.

[0012] The transparent electrode by which the laminating of this invention according to claim 3 was carried out one by one on the transparent board and the aforementioned transparent board, It is organic EL display device whose fields which have luminescent color material and a metal electrode, and touch the aforementioned transparent electrode of the aforementioned transparent board have the shape of a predetermined number of a minute convex lens. The metal electrode corresponding to this minute convex lens serves as many minute concave mirrors, respectively, since light is converged, probability which carries out outgoing radiation of the light above a critical angle is made small, optical ejection efficiency improves, and it has operation that a bright display device can be obtained.

[0013] The transparent electrode by which the laminating of this invention according to claim 4 was carried out one by one on the transparent board and the aforementioned transparent board, The field of the side which has luminescent color material and a metal electrode, and is not in contact with the aforementioned transparent electrode of the aforementioned transparent board has the shape of a convex lens of one sheet. The field which touches the aforementioned transparent electrode of the aforementioned transparent board is organic EL display device which have the shape of a predetermined number of a minute convex lens, and by many minute concave mirrors' converging light, and letting a convex lens pass, optical ejection efficiency improves and it has operation that a bright display device can be obtained.

[0014] The transparent electrode by which the laminating of this invention according to claim 5 was carried out one by one on the transparent board and the aforementioned transparent board, It is organic EL display device which have the shape of a predetermined number of a minute convex lens in which it has luminescent color material and a metal electrode, and both sides of the aforementioned transparent board ****ed. Many minute concave mirrors converge light, and optical ejection efficiency improves by letting a minute concave mirror and the minute convex lens which corresponded by 1 to 1 pass, and it has operation that a bright display device can be obtained.

[0015] this invention according to claim 6 has the transparent electrode, luminescent color material, and metal electrode by which the laminating was carried out one by one on the transparent board and the aforementioned transparent board, the field of the side which has not touched with the aforementioned transparent electrode of the aforementioned transparent board is organic EL display device which have the shape of a predetermined number of a minute convex lens, and its optical ejection efficiency improves by letting many minute convex lenses pass, and it has operation that a bright display device can be obtained.

[0016] The claim 3 in which the minute convex lens is formed for every pixel of a matrix type display, respectively, or 6 is organic EL display device of a publication either, by letting the convex lens which the concave mirror corresponding to each pixel converged light, and corresponded by the pixel and 1 to 1 pass, optical ejection efficiency of an according to claim 7 this invention improves, and it has operation that a bright display device can be obtained.

[0017] The claim 3 which a minute convex lens makes the 1-pixel unit containing the red, green, and blue of a matrix type display and which is formed for every picture element, or 6 is organic EL display device of a publication either, by letting the convex lens which the concave mirror corresponding to each picture element converged light, and corresponded by the picture element and 1 to 1 pass, optical ejection efficiency of an according to claim 8 this invention improves, and it has operation that a bright display device can be obtained.

[0018] The claim 1 which has an electric insulating plate on a metal electrode, or 8 is organic EL display device of a publication either, and this invention according to claim 9 has operation that it can do lightweight and cheaply, by losing an electric insulating plate.

[0019] Hereafter, it explains about the gestalt of each operation of this invention, referring to a drawing.

[0020] (Gestalt 1 of operation) It explains hereafter, referring to a drawing about the gestalt of operation of this invention 1st.

[0021] Drawing 1 shows the cross section of the organic EL element which raised luminescence ejection efficiency. In drawing 1 , 11 is a transparent board and is a convex lens of one side which mainly consists of transparent glass or a transparent resin board. 12 is a transparent electrode and mainly uses ITO of transparent electric conduction material. 13 names generically the material which is luminescent color material and manages the mechanism of luminescence. 14 is a metal electrode and the metal whose work function of aluminum, lithium-magnesium, etc. is about five is used. 15 is an electric insulating plate, a metal electrode 14 is electrically separated with other matter, or a cascade screen is protected, and this electric insulating plate 15 also has the case of a glass plate and an insulating thin film. In the case of an insulating thin film, the circuit board may be added to a field opposite to a metal electrode 14. Although the laminating of the electric insulating plate 15 is carried out after using the transparent board 11 as a substrate and carrying out the laminating of the thin film-like transparent electrode 12, the luminescent color material 13, a metal electrode 14, and the film of ********** one by one from on the as a method of forming a display device, an electric insulating plate 15 may be omitted depending on the case.

[0022] After using an electric insulating plate 15 as a substrate and carrying out the laminating of each film of the thin film-like metal electrode 14, the luminescent color material 13, and a transparent electrode 12 one by one as another creating method, the laminating of the transparent board 11 is carried out.
[0023] The transparent board 11 starts the square inscribed in the circle of an one side convex lens, as shown in drawing 2 . Drawing 2 (a) is drawing which looked at the one side lens from the top, and (b) is the cross section of the AA' cross section. A rectangle is sufficient although drawing 2 showed what was started for the square.
[0024] The transparent board 11 of the difference between the conventional organic EL element and the gestalt of this operation is the difference of an parallel plate or an one side convex lens. The cross section of the surface portion of a transparent board is shown in drawing 3 with the conventional example. Drawing 3 (a) shows the conventional element and (b) shows the cross section of the gestalt of this operation. The light emitted from the luminescence material of the luminescent color material 13 passes the electron hole transportation material in the luminescent color material 13, and a transparent electrode 12, and reaches the transparent board 11. In this drawing, light penetrates to up to a lower shell. The layer of electron hole transportation material and a transparent electrode 12 is 50-100nm, respectively, and since the refractive index of ITO is about 1.8 and the refractive index when using the transparent board 11 as glass is about 1.5 when ITO is used for a transparent electrode 12, it is thought that the light from luminescence material goes straight on mostly to the transparent board 11.
[0025] Then, although outgoing radiation cannot be carried out to the observation side which is the opposite side of a laminating side, the light by which outgoing radiation is carried out with a critical angle theta can also pass the transparent board 11, the outgoing radiation of it can be carried out to an observation side, and the light which carried out incidence with the critical angle theta as shown in drawing 3 (a) can sense it as a light, since it makes the datum line the tangent g of the outgoing radiation point P, when having become one side convex lens-like, as shown in (b That is, the ejection efficiency of light can be raised and a display brighter than the conventional thing can be performed.
[0026] (Gestalt 2 of operation) It explains hereafter, referring to a drawing about the gestalt of operation of this invention 2nd.

[0027] Drawing 4 shows the cross section of the organic EL element in the gestalt of the 2nd operation. In drawing 4 , a transparent board and 22 of 21 are the same as that of a transparent electrode and the thing 23 explained luminescent color material and 24 to be by the metal electrode and drawing 1 25 is an electric insulating plate and is [ drawing 1 ] the gestalt of the 1st operation, respectively.
[0028] The portion in which a transparent electrode 22, the luminescent color material 23, a metal electrode 24, and an electric insulating plate 25 see from an observation side, and become concave surface-like, therefore, as for a different point from the gestalt of the 1st operation, form the electrode of a metal electrode 24 in connection with that the transparent board 21 is a double-sided convex lens and it is with a bird clapper at a concave mirror. Drawing 3 (c) shows the cross section of the surface portion of the organic EL-element transparent board in the gestalt of this operation. The light which carried out outgoing radiation with the critical angle theta as the gestalt of the 1st operation explained passes the transparent board 21 by P points, can carry out outgoing radiation to an observation side, and can be sensed as a light. Since the metal electrode furthermore forms the concave mirror, light is not made to emit, but it condenses, and becomes brighter than the case of a flat surface. From the above reason, compared with the conventional example, the ejection efficiency of light can be raised and a bright display can be performed.
[0029] (Gestalt 3 of operation) It explains hereafter, referring to a drawing about the gestalt of operation of this invention 3rd.

[0030] Drawing 5 shows the conceptual diagram of the organic EL element in the gestalt of this operation, this drawing (a) is a plan and this drawing (b) is a cross section. It is the display device of the matrix type displayed in the pixel unit which is used for image display etc. as shown in drawing 5 , and consists of m lines (lengthwise [ of a drawing ]), and an n train (longitudinal direction). In this drawing, 36 shows a convex lens.
[0031] Drawing 6 is the expanded sectional view of the organic EL element in the gestalt of this operation.
[0032] In drawing 6 , 31 is a transparent board, and as shown in drawing 5 , the convex lens and observation side is constituted from the pixel unit by the flat surface at the laminating side. 32 is a transparent electrode, is a thin film to which each has the field of concave in the transparent board 31 side of a convex lens, and has become the common electrode of the line writing direction which put the pixel lengthwise [ each ] in a row. The luminescent color material of the thin film to which each has the field of concave in the transparent board 31 side, and 34 are the metal electrodes of the thin film to which each has a concave field in the transparent board 31 side, and 33 forms a concave mirror for every pixel. Moreover, it is the common electrode of the direction of a train which put the pixel of each longitudinal direction in a row. 35 is an electric insulating plate which has a concave field in a metal-electrode 34 side, as the gestalt of the 1st operation explained, it separates a metal electrode 34 electrically with other matter, and it protects a cascade screen, and this electric insulating plate 35 also has the case of a glass plate and an insulating thin film. In the case of an insulating thin film, the circuit board may be added to a field opposite to a metal electrode 14. Furthermore, when it carries out a laminating, using the transparent board 31 as a substrate, this electric insulating plate 35 may not be formed.
[0033] Drawing 7 is the expanded sectional view of the convex lens portion of the transparent board 31, this drawing (a) is the element of the gestalt of this operation, and this drawing (b) is the thing of the conventional element. Total reflection of the light which drawing 7 (b) shows about the case of a transparent board without the same lens as drawing 3 (a) which is the conventional example, and was emitted from the luminous layer of luminescent color material on the larger square gamma

than a critical angle theta is carried out in the glass interface which touches the air which is an observation side, and it does not reach an observation side.
[0034] On the other hand, drawing 7 (a) shows one pixel of drawing 6 , and it is reflected with the concave mirror of a metal electrode 34 at once, and the light of the outgoing radiation angle gamma emitted from A points becomes perpendicularly mostly to the interface of glass and air, and reaches an observation side. Moreover, since the direct light from A points can also reach an observation side and can make the light of the latus range reach, luminescence ejection efficiency increases compared with the case of drawing 7 (b), and a bright display can be performed.
[0035] (Gestalt 4 of operation) It explains hereafter, referring to a drawing about the gestalt of operation of this invention 4th.
[0036] this invention relates to the display device of the matrix type displayed per pixel like the gestalt of the 3rd operation.
[0037] Drawing 8 shows the cross section of the gestalt of this operation which is the organic EL element which raised the luminescence ejection efficiency in a matrix type display.
[0038] In drawing 8 , 41 is a transparent board, and the observation side which is a lens convex in the pixel unit as the transparent board 31 of drawing 6 with the same laminating side, and is a laminating and opposite side forms the convex lens of one one side in a laminating side by the same whole display device as drawing 1 which is the gestalt of the 1st operation. Luminescent color material, 44 metal electrodes, and 45 are electric insulating plates, and a transparent electrode and 43 of 42 are the same as that of the transparent electrode 32 of drawing 6 , the luminescent color material 33, a metal electrode 34, and an electric insulating plate 35 respectively.
[0039] With the gestalt of this operation, since in addition to the operation explained with the gestalt of the 3rd operation the observation side forms the convex lens of one one side by the whole display device as mentioned above, operation that luminescence ejection efficiency improves compared with the case where the interface by the side of observation is a flat surface as the gestalt of the 1st operation explained is also added. That is, compared with the gestalt of the 3rd operation shown by drawing 6 , luminescence ejection efficiency can improve and a bright display can be performed.
[0040] (Gestalt 5 of operation) It explains hereafter, referring to a drawing about the gestalt of operation of this invention 5th.
[0041] It is related with the display device of the matrix type displayed per pixel like the gestalt of operation of this invention 3rd.
[0042] Drawing 9 shows the cross section of the gestalt of this operation which is the organic EL element which raised the luminescence ejection efficiency in a matrix type display.
[0043] In drawing 9 , 51 is a transparent board, the observation side which is a lens convex in the same pixel unit as the transparent board 31 of drawing 6 , and is a laminating and opposite side is a convex lens, and the laminating side forms one double-sided convex lens in a laminating side for every pixel at the convex lens [ for every pixel by the side of a laminating ], and observation side to which it corresponded by 1 to 1. Luminescent color material, 54 metal electrodes, and 55 are electric insulating plates, and a transparent electrode and 53 of 52 are the same as that of the transparent electrode 32 of drawing 6 , the ****** color material 33, a metal electrode 34, and an electric insulating plate 35.
[0044] Drawing 10 is the expanded sectional view of the transparent board 51 of the gestalt of this operation, this drawing (a) is the element of the gestalt of this operation, and this drawing (b) is the element of the conventional example. Total reflection of the light which drawing 10 (b) shows about the case of a transparent board without the same lens as drawing 3 (a) which is the conventional example, and was emitted from the luminous layer of luminescent color material on the larger square gamma than a critical angle theta is carried out in the glass interface which touches the air which is an observation side, and it does not reach an observation side.
[0045] On the other hand, drawing 10 (a) shows one pixel of drawing 9 , and it is reflected with the concave mirror of a metal electrode at once, and the light of the outgoing radiation angle gamma emitted from A points is refracted in the direction of a convex to the interface of glass and air at the contact which makes the focus of a convex lens a normal, and reaches an observation side. Moreover, since the direct light from A points can also reach an observation side and can make the light of the latus range reach, luminescence ejection efficiency increases compared with the case of drawing 10 (b), and a bright display can be performed.
[0046] In addition, although the example constituted from a matrix display of a pixel unit explained with the gestalt of the 3rd of the above matrix type display, 4, and operation of five, it can carry out similarly about what was constituted from red, green, and a matrix display that made the unit the picture element which consists of 1 pixel each of blue like color display.
[0047] (Gestalt 6 of operation) It explains hereafter, referring to a drawing about the gestalt of operation of this invention 6th.
[0048] this invention relates to the color display element of the matrix type which displays red, green, and blue in the picture element unit made into a 1-pixel each unit.
[0049] Drawing 11 shows the cross section of the gestalt of this operation which is the organic EL element which raised the luminescence ejection efficiency in matrix type color display.
[0050] In drawing 11 , 61 is a transparent board, it is a flat surface, and the observation side which is a laminating and opposite side is a convex lens, and the laminating side forms one one side convex lens for every picture element. the case where 62 makes monotonous the transparent electrode 32 in the gestalt of the 3rd operation with which a transparent electrode and 63 are electric insulating plates, and indicated luminescent color material, 64 metal electrodes, and 65 to be by drawing 6 , the ****** color material 33, a metal electrode 34, and an electric insulating plate 35 -- ** -- although it is the same, as 1 picture element unit, for every pixel, the luminescent color material 63 is in red (R), green (G), and each blue (B) luminescent color material, and is classified
[0051] If it thinks per picture element, the gestalt of this operation will be considered to be the gestalt of the 1st operation

shown by drawing 1 and drawing 3 the same way. So, an observation side can be reached, luminescence ejection efficiency increases compared with the conventional example, and the light which carried out outgoing radiation on the larger square than a critical angle theta can also perform a bright display.

[0052] In addition, although the example constituted from a matrix display of a picture element unit explained in the above explanation, it can carry out similarly about what constituted the pixel from a matrix display made into the unit like the gestalt of the 3rd, 4, and operation of five.

[0053] Moreover, although the gestalt of the above operation explained the case where an electric insulating plate was prepared in a metal-electrode side, it cannot be overemphasized that it can carry out similarly about composition without an electric insulating plate.

[0054]

[Effect of the Invention] As mentioned above, according to this invention, the display observation side of the transparent board of organic EL display device is made into the shape of a convex lens, or a luminescent color timber-volume layer side is made into the shape of a convex lens, and since luminescence ejection efficiency can be increased by things, using a metal electrode as a concave mirror, power consumption is not increased but the advantageous effect that an indication can be given bright is acquired.

---

[Translation done.]

* NOTICES *



1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

---

PRIOR ART

---

[Description of the Prior Art] The transparent electrode 62, luminescent color material 63 (the hole-injection material 71, the electron hole transportation material 72, the luminescence material 73, electronic transportation material 74) which are represented by the transparent and monotonous glass plate 71 and ITO like [ in the conventional organic EL display device ] drawing 12 , If a metal electrode 64 is used as cathode, a transparent electrode 62 is used as an anode plate and voltage is impressed with the composition which carried out the laminating of a metal electrode 64 and the electric insulating plate 65 one by one, light will excite by the luminescence material 73 in the luminescent color material 63, and the light will reach outside through the monotonous glass plate 71.

---

[Translation done.]

---

PRIOR ART

---

[Description of the Prior Art] The transparent electrode 62, luminescent color material 63 (the hole-injection material 71, the electron hole transportation material 72, the luminescence material 73, electronic transportation material 74) which are represented by the transparent and monotonous glass plate 71 and ITO like [ in the conventional organic EL display device ] drawing 12 , If a metal electrode 64 is used as cathode, a transparent electrode 62 is used as an anode plate and voltage is impressed with the composition which carried out the laminating of a metal electrode 64 and the electric insulating plate 65 one by one, light will excite by the luminescence material 73 in the luminescent color material 63, and the light will reach outside through the monotonous glass plate 71.

---

[Translation done.]

## EFFECT OF THE INVENTION

[Effect of the Invention] As mentioned above, according to this invention, the display observation side of the transparent board of organic EL display device is made into the shape of a convex lens, or a luminescent color timber-volume layer side is made into the shape of a convex lens, and since luminescence ejection efficiency can be increased by things, using a metal electrode as a concave mirror, power consumption is not increased but the advantageous effect that an indication can be given bright is acquired.

[Translation done.]